



# Nitrogen Management: Almonds – Where We've Been, Where We're Going

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Reactive Nitrogen Workshop  
June 5, 2013

# California Almonds and the Almond Board of California

Spanning 500 miles throughout the Central Valley

100% of U.S. production

6,000+ growers, 100 “handlers”

Approximately 80% of worldwide production

2011: 2 bill lb crop

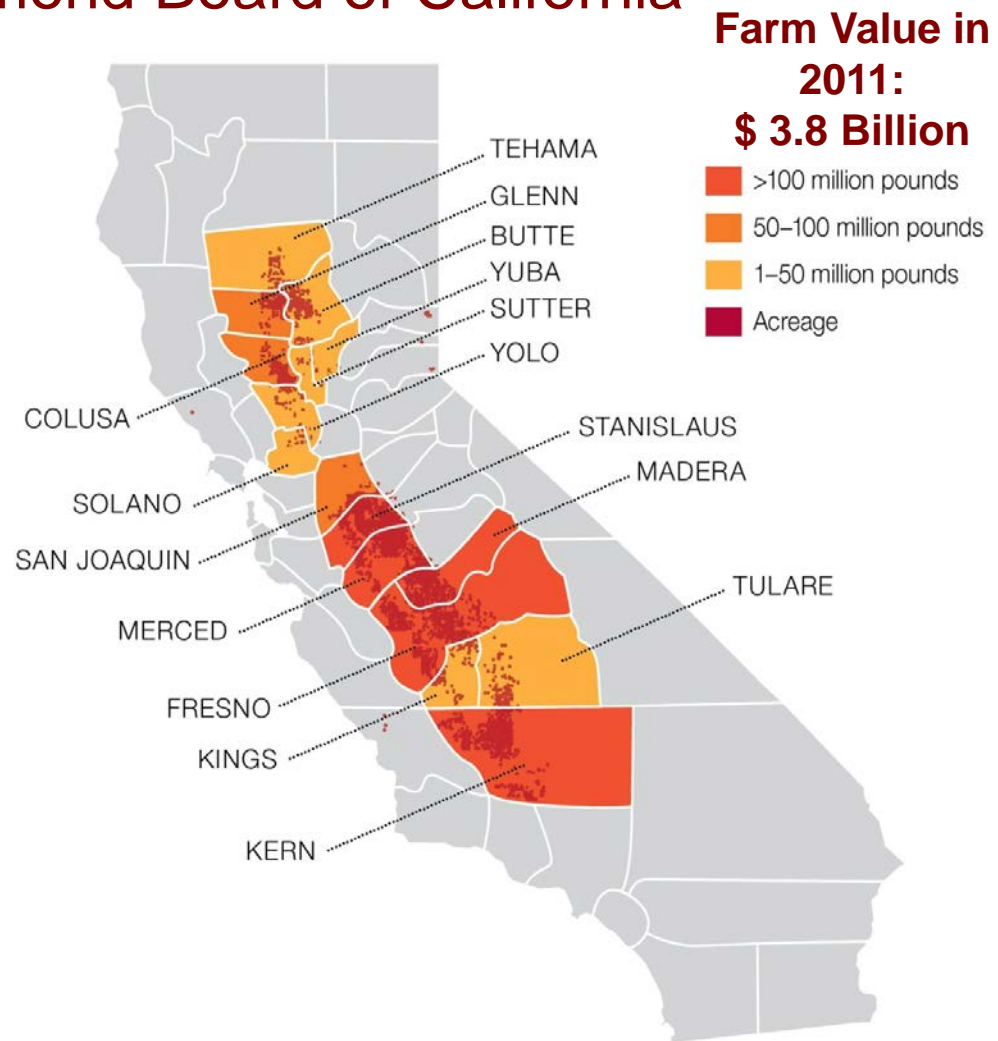
Top U.S. horticultural crop in export value

# 3 in acreage in California (~800,000 A)

ABC is a grower-enacted “Federal Marketing Order” established in 1950

- All growers and handlers (processors) are members

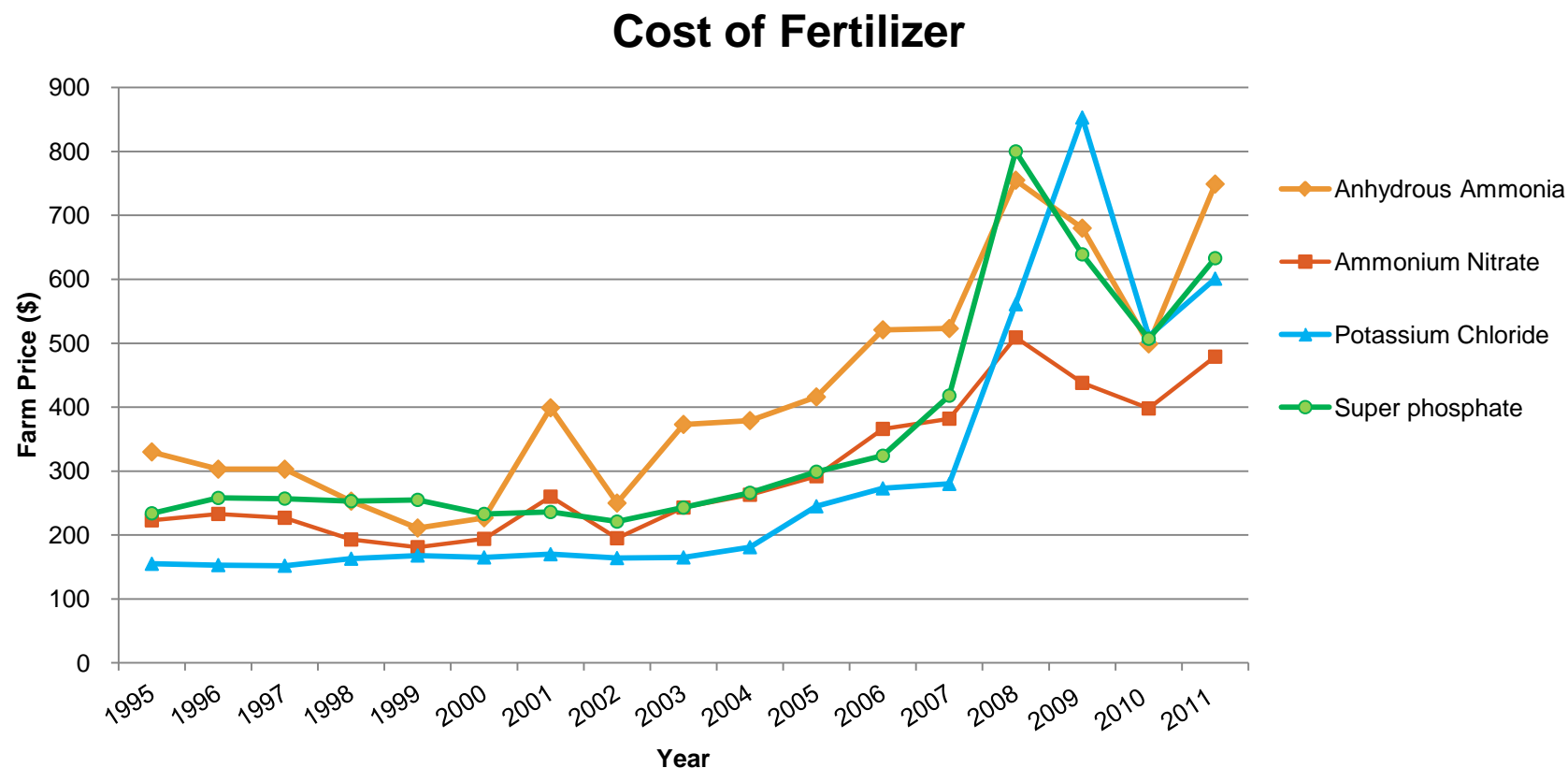
Operates under supervision of USDA-AMS



Source: NASS CFO



# Trends in Cost of N, P & K Fertilizers

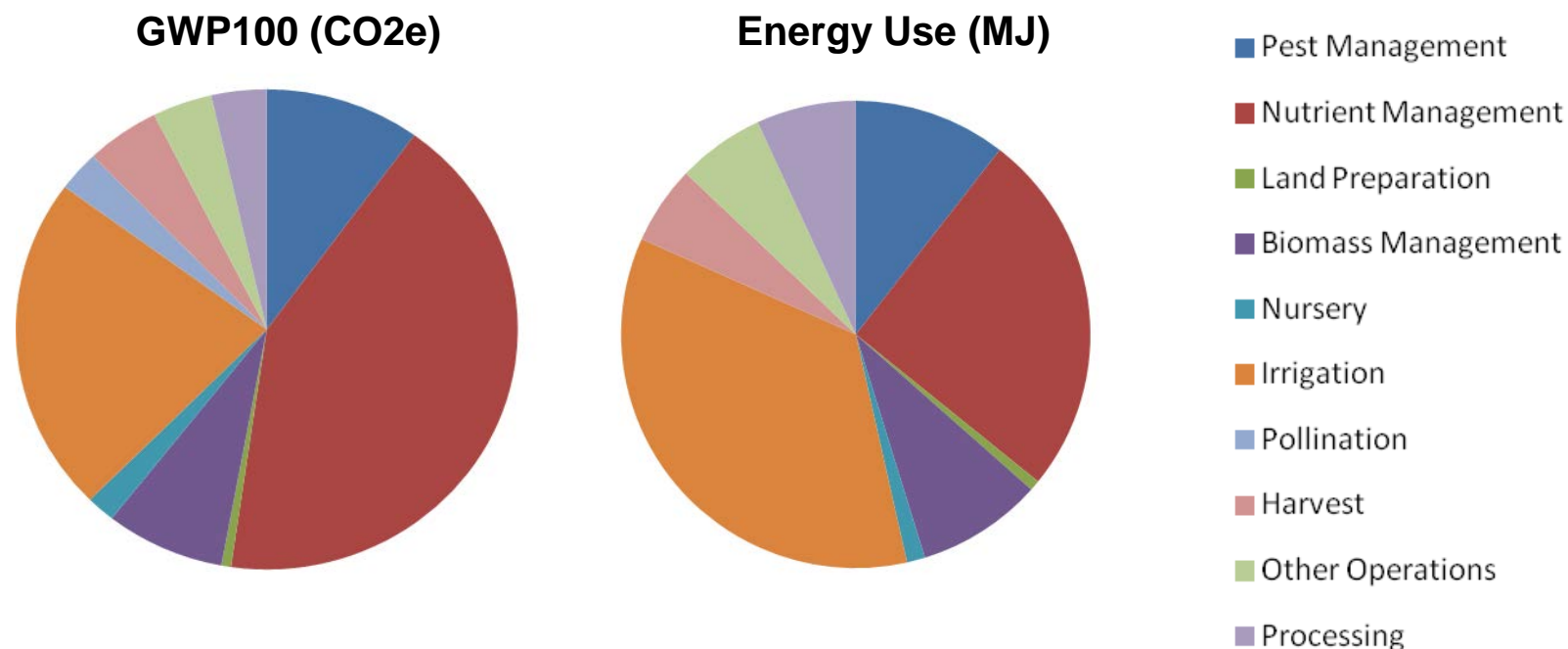


Source: <http://www.ers.usda.gov/Data/FertilizerUse/>

# Research and Practices Then (1970s – 1980s) vs. Now (2012/3)

	1970s-1980s	2012
Crop demand	<ul style="list-style-type: none"> <li>•Primary factor dictating N use – crop potential</li> <li>•50 # N removed per 1000 # kernels</li> </ul>	<ul style="list-style-type: none"> <li>• 55 – 70 # N removed per 1,000 # kernels</li> </ul>
Yield vs. N use	<ul style="list-style-type: none"> <li>•Best practice: 2,000 # kernel yield with 200 # N</li> <li>•The norm: 1,200-1,300 # kernel yield with 200 # N</li> </ul>	<ul style="list-style-type: none"> <li>• 4,000 # kernel yield with 275 # N</li> </ul>
Nitrogen Use Efficiency (NUE)	<p>Best practice: 50%</p> <p>The norm: 42-46%</p>	<ul style="list-style-type: none"> <li>• 75 – 85%</li> </ul>
Timing	<ul style="list-style-type: none"> <li>•1 or 2 apps in-season</li> </ul>	<ul style="list-style-type: none"> <li>• “Spoon feeding” – multiple apps, low doses</li> <li>• Match demand during tree growth and crop development</li> </ul>
Application	<ul style="list-style-type: none"> <li>• Broadcast or banded</li> <li>• Flood or impact sprinkler</li> </ul>	Fertigation through drip or microsprinkler
Leaf sampling	July leaf sample linked to next year’s crop	<ul style="list-style-type: none"> <li>• Early season leaf sampling - adjustments for this year’s crop</li> <li>•Improved leaf sampling - addresses orchard variability</li> </ul>
Fertility budgeting	N fertilization model	Goal: Updated for more than just N

# Energy and Greenhouse Gas Emissions from Almond Production (nursery through brown skin almond)



**Figure 2.** Breakdown of GHG emissions and Energy Emissions by Operation

From: Kendall, AM, S Brodt, E Marvinney (2012): Greenhouse Gas and Energy Footprint (Life Cycle Assessment) of California Almond Production. Annual Report to the Almond Board of California 2012.  
<http://www.almondboard.com>

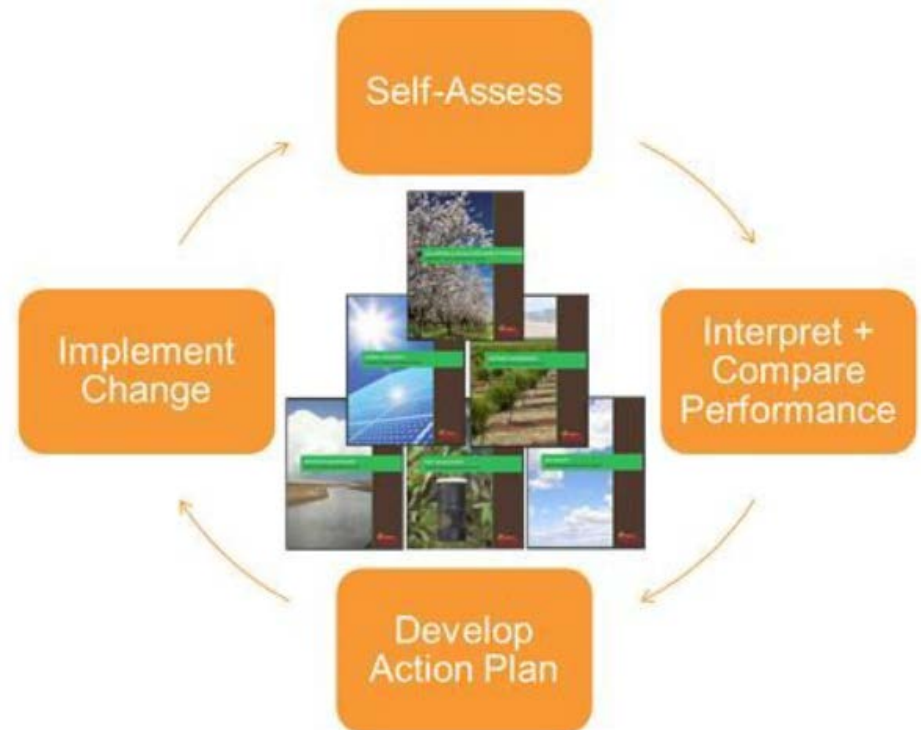


# California Almond Sustainability Program:

•Five self-assessment Modules now complete; developed with grower and expert input

- Irrigation Management
- Nutrient Management
- Energy Management
- Pest Management
- Air Quality

[www.sustainablealmondgrowing.org](http://www.sustainablealmondgrowing.org)



# Data to Date from California Almond Sustainability Program

Practice	Response	% of orchards ± 95% confidence level	Why not? (% of orchards)		
			Not familiar	Not tried	Have tried
<b><u>Source of Nutrients</u></b>					
Sources of nitrogen	Fertilizer Manure Compost Cover Crops	85.4 9.1 22.5 10.3			
Of orchards using compost, manure and/or N-fixing cover crops...					
Calculations of total nitrogen applied include contributions from these sources	Yes No	43.5 ± 7.3 56.5 ± 7.3	8.5	34.5	13.6
Nitrogen content of irrigation well water was analyzed in past 3 years	Yes No	57.8 ± 6.1 42.2 ± 6.1	5.1	25.4	11.7
Of orchards where tests verify well water used for irrigation contains nitrogen...					
Calculations of total nitrogen applied include nitrogen from well water	Yes No	56.3 ± 6.8 43.7 ± 6.8	8.7	25.7	9.2
<b><u>Amount of Nutrients</u></b>					
Calculated fertilizer rates are based on yield estimates and nutrient amounts removed by hulls, shells & nuts	Yes No	81.1 ± 4.2 18.9 ± 4.2	4.9	7.3	6.7
Plant tissues are sampled and tested annually before applying nutrients to inform fertility management decisions	Yes No	89.2 ± 3.4 10.8 ± 3.4	2.8	2.8	5.1
Plant tissues used for nutrient tests are sampled using recommended procedures	Yes No	87.8 ± 3.6 12.2 ± 3.6	2.2	4.8	5.1
Results of nutrient tests are mapped to guide precision fertilizer applications	Yes No	19.8 ± 4.6 80.2 ± 4.6	5.8	63.8	10.6



# Almond Board of California Research Projects

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- **Brown\*** Nutrient Budget Approach to Fertilizer Management in Almonds
  - **Shackel/Sanden\*** Fertigation: Interaction of Water and Nutrient Management in Almonds
  - **Hopmans\*** Optimization of Water and Nitrate Use Efficiencies for Almonds under Micro-Irrigation
  - **Brown\*** Root Distribution and N Uptake
  - **Lampinen\*** Mobile Platform to Measure Canopy Light Interception and Water Stress
  - **Smart\*** Eval CA Almond for Root & Soil Carbon; Greenhouse Gas; Nitrogen Effic.
  - **Viveros** Execution and Extension of Info for Nutrient budget Approach Project 11-PREC2-Brown
  - **DeJong** Assessing the Carbon Budget of Almond Trees & Develop Model
  - **Kendall** Life Cycle Assessment of GHG Emissions for Almond Production
  - **Smart, Brown, Harter:** BMPs and Nitrate Leaching (Funding from FREP)
- \* Co-funded by USDA SCRI Grant (2008-2013)